17.4.1.1 WAG ERA Results. The WAG ERA results are summarized and discussed in "Problem Formulation" (Section 17.2) and in appendices H1 and H2. The risk assessment results from the WAG ERAs indicate that most of the contamination associated with INEEL operations is localized to only a few areas in the WAGs. Additionally, many of the WAG sites have already undergone remediation for human health risk or ecological risk, and most or all of the contamination has been removed. Other remedial actions may include institutional controls or a management plan that will limit access to the site. For those sites having neither planned remediation nor institutional controls to prevent intrusion or access by ecological receptors, some potential for risk will remain.

Tables 17-14 through 17-24 (Section 17.3.2) present the receptors, by functional group, with hazard quotients in excess of 10 by WAG for nonradionuclides selected as OU 10-04 ERA COPCs. Tables 17-27 and 17-28 summarize the WAG ERA nonradionuclide COPCs results at the individual WAGs and the receptors of concern potentially affected by these COPCs. Radionuclides have not been of great concern for ecological receptors in the WAG ERAs and could not be evaluated using the same approach. However, they were retained as OU 10-04 COPCs due to a common presence across the INEEL. This information is also summarized in the last column of Table 17-26.

In Table 17-27, the column next to each receptor shows how many of the WAGs contained the OU 10-04 ERA COPC with an HQ value greater than or equal to 10 for that receptor or functional group. WAG 7 has no data concerning the receptors of concern, and WAGs 6 and 10 were combined into one WAG for the purposes of this evaluation.

From Table 17-27, it can be seen that chromium, copper, cyanide, manganese, nickel, selenium, silver, thallium, and vanadium are generally not issues for avian species, with the exception of insectivores (which are modeled in a very conservative manner), but are issues for the mammalian herbivores. Copper is a COPC for avian omnivores as well. Cadmium, lead, mercury, and zinc are of concern to both avian and mammalian receptors and plants. Barium is a COPC for mammalian receptors. No TRVs were available to evaluate barium, strontium or the organics as listed for risks to avian species.

An evaluation of the OU 10-04 ERA COPCs for each functional group (and certain species of concern such as the pygmy rabbit, ferruginous hawk, bald eagle, peregrine falcon, and plant communities) was conducted for each WAG. An HQ exceeding 10 was also used to evaluate the functional groups. By assessing the groups with HQs greater than 10, a picture was developed as to which functional groups and receptors are potentially affected the most by the COPCs, and at which locations effects may occur (see Table 17-28). This information allows for selecting the key receptors for long-term monitoring studies.

Mercury was the only COPC that had at least one HQ greater than 10 in all functional groups and species of concern. Cadmium, chromium, lead, and zinc all had HQs greater than 10 in most of the functional groups.

Mammalian omnivores had the greatest number of COPCs with HQ values greater than 10 at the greatest possible number of WAGs. A common species in this functional group, the deer mouse, is ubiquitous across the INEEL. For this reason, the deer mouse may be a suitable species for long-term monitoring. The avian functional group with the greatest number of COPCs with HQs greater than 10 was the avian insectivores. Due to data gaps, the insectivores were conservatively modeled. However, the European starling and the brown-headed cowbird both are found on the site and are part of this functional group. The brown-headed cowbird was sited more frequently than the European starling in the Breeding Bird Surveys conducted at the INEEL from 1980 to the present. Due to its greater abundance and distribution across the site, the brown-headed cowbird may make a suitable long-term monitoring species.

Table 17-28. Evaluation of HQs for COPCs and WAGs for functional group and associated receptors.

Key Receptor or Functional Group	Number of COPCs with HQs >10	Number of WAGs having HQs >10
Avian carnivores (burrowing owl and loggerhead shrike)	6	6/8
Avian herbivores (mourning dove)	6	7/8
Avian insectivores (sage sparrow)	14	7/8
Avian omnivores (black-billed magpie)	7	6/10
Ferruginous hawk, peregrine falcon, bald eagle	6	5/8
Mammalian carnivores (coyote)	4	5/8
Mammalian herbivores (mule deer)	17	7/8
Mammalian insectivores (Townsend's big-eared bat)	19	7/86
Mammalian omnivores (deer mouse)	21	7/8
Pygmy rabbit	16	7/8
Plant communities	12	7/8

17.4.1.2 OU 10-04 ERA Sampling and Risk Analysis Results. The sampling and risk results for the 1997 OU 10-04 ERA sampling indicate that there is negligible potential for the spread of metals or radionuclide contamination from WAG 3 to the offsite reference area. Onsite and offsite risks were similar, and also both sets of risk results were similar to or less than risks calculated for the INEEL soil background data. Uncertainty remains pertaining to the Waste Calcining facility since organics may be of concern and were not included in the 1997 sampling. Sampling and risk results for the BORAX area indicate little or no migration of radionuclides from under the engineered soils cap at BORAX-02 (buried reactor site).

A comparison of site-specific uptake factors to literature values is presented in Section 17.3.3 (Table 17-25) and in Appendix H3. The results indicate that the use of literature values for the food web modeling is conservative and likely to overestimate potential dietary ingestion risks for several metals.

17.4.1.3 Spatial Analysis. The spatial analysis is presented in the analysis phase (Section 17.3.1). The amount of habitat potentially adversely affected was determined by overlaying the delineation of contaminant spatial extent map onto the INEEL vegetation map and evaluating the habitat composition inside the contamination isopleths. The summary of habitats (by vegetation class) across the INEEL and within the final OU 10-04 assessment areas are presented in Table 17-12.

The results of the evaluation were discussed by WAG ERA assessment areas and by the ordnance sites. Ordnance sites were evaluated separately due to the larger area of impact and the different contaminants. These ordnance sites are typically less disturbed, and, therefore, provide better habitat in the area (that is, most of the WAG areas are disturbed by facility activities). The total INEEL is approximately 230,617 ha, with the WAG assessment areas impacting approximately 4,317 ha or 1.87% of this total. The ordnance areas include approximately 5,977 ha or 3% of this total. These two areas are approximately 5% of the total INEEL. As seen in Table 17-12, the majority of the WAG and ordnance areas are on sagebrush-steppe both on and off lava. The percentage of total area (WAG assessment areas and ordnance) was compared to the selected endpoint as discussed in Appendix H6 to evaluate risk to ecological populations at the facility.

Based on the *de minimis* risk definition, risk corresponds to (1) less than 20% reduction in the abundance or production of an endpoint population within suitable habitat within a unit area, (2) loss of less than 20% of the species in an endpoint community in a unit area, or (3) loss of less than 20% of the area of an endpoint community in a unit area. Here the term "unit area" refers to a discrete area that is at risk and may be subject to a regulatory or remedial action.

The sagebrush-steppe is a broad category encompassing many diverse ecological communities. These communities are presented in Table 17-12 and Figure 17-6 (vegetation classes graphic). Communities are defined as "populations of many species that interact," and for this assessment it is acceptable to consider the INEEL sagebrush-steppe as a broad community that can be evaluated on a larger scale.

The modeled area potentially affected by the contaminants identified from the ERA sampling at the INEEL, is, therefore, less than 5% of the total area. This is significantly less than the 20% loss of area in the endpoint community accepted by the definition of *de minimis* risk (Appendix H6).

17.4.2 Risk Description

After risks have been estimated, risk assessors need to integrate and interpret the available information into conclusions about risks to the assessment endpoints. EPA guidance (April 1998) suggests that the risk characterization include evaluation of multiple lines of evidence (also referred to as a weight of evidence evaluation). Development of lines of evidence provides both a process and framework for reaching conclusions regarding confidence in the risk estimates (EPA 1998). The process includes evaluation of all available and pertinent information, even if qualitative in nature. Such sources of supporting information are used in conjunction with the quantitative risk assessment results to reach summary level conclusions and recommendations for the risk managers.

The results of the spatial estimation indicate that *de minimis* risk is produced due to contamination impact on the INEEL endpoint community. The extent of contamination is modeled to be present at significantly less than the 20% loss of total area in the endpoint community (sagebrush steppe), and it was concluded that WAG activities at the facilities have minimal impact on the ecological communities present at the INEEL. This conclusion is further supported by the information summarized in the lines of evidence table (Table 17-29). The far right column provides a ranking of the overall value rating from low to high and whether the results support (+) or do not support (-) the overall risk conclusions.

The BBS and the long-term vegetation transect studies are two of the strongest supports for this conclusion. The BBS are discussed in Section 17.2.4.1 and Appendices H10 and 11. The bird population trends based on the data gathered from the BBS from 1985 to 1999 are summarized in Table 17-9. Bird populations from the state of Idaho and the nation as a whole from the past 20 years were analyzed in a similar timeframe as surveys conducted at the INEEL from 1985 to 1999. Breeding bird populations on the INEEL for the seven target species have remained constant, except for an increase in the number of mourning doves. However, this study did not assess plots near the facilities against the plots in less impacted areas at the INEEL.

Table 17-29. Lines-of-evidence evaluation for the OU 10-04 ERA

Item	Strengths	Weaknesses	Results	Overall Lines of Evidence Rating for the OU 10-04 Site-wide ERA (+/-)[a]
Ecologically Sensitive Areas overlay map (Section 17.2.4.2)	Identifies areas of special concern to ecological receptors	Characterization has significant uncertainty; much of the characterization was extrapolated.	None of the WAG facilities are directly within the buffer for protected areas. However, several of the WAGs either border or fall within sensitive biological resource areas.	Medium (+)
ERA sampling (1997) at INTEC (Appendix H3)	Multi-media, radionuclides and inorganics, onsite and offsite, identified possible spread of contamination from WAG area, used to evaluate food web modeling assumptions	Small sample size, no organic analyses, problem with detection limits for some analytes, not representative of the INEEL, sampling did not include organics	Risks for onsite locations were less than or equal to background or the reference area; no apparent biotic uptake or movement of contamination off-site occurring	Low value for site-wide characterization (+) Medium value for modeling verification (++)
ERA sampling (BORAX 2000) (Appendices C and H3)	Multi-media, radionuclides and inorganics	No offsite data; comparison of data to earlier reference area and background data sets	Risks for onsite locations were less than or equal to background or the reference area; no apparent biotic uptake or movement of contamination off-site occurring	Low value (+)
Breeding Bird Surveys (Appendices H10 & 11)	Multi year (1960s to present), nation-wide, strong and consistent methodology;	Not done every year from 1999 to present; inadequate route coverage for western U.S. limits comparisons; weather conditions can be a limiting factor during survey dates, near facility routes not compared to off facility routes	More birds and more bird species seen/heard in 1999 than previous years back to 1985; some bird species experienced declines but these reflect State declines as well	High value (+)

Table 17-29. (continued).

Item	Strengths	Weaknesses	Results	Overall Lines of Evidence Rating for the OU 10-04 Site-wide ERA (+/-)[a]
Long-term Vegetation Transects (Appendix H12)	From 1950 to1995 with 9 samplings; core and non-core transects; consistent methodology applied	Results prone to variance with drought and fire; study cannot be used strictly to assess grazing effects, not located in known areas of sensitive habitat	Little evidence of directional changes other than increase in rabbitbrush and cheatgrass; results would indicate that current conditions reflect earlier heavy grazing prior to establishment of the INEEL	High value (+)
RESL Radiological data (Appendix H4)	Numerous studies; many different biota tissues sampled from around 1978 through the 80's.	Radionuclides only; may not be adequately conservative for TRA; no co-located soil data collected; data collected for research- not usable for risk assessment purposes, lacks sufficient documentation on many studies, studies not directed at risk characterization, studies performed during 70's and 80's with significant remediation efforts occurring since that time	Indicates significant radionuclides present in biota in the past; however, of limited value since conclusive results can not be obtained from different studies over many years by different researchers	Low value (-)
Warm Waste Ponds Air Dispersion Modeling (Appendix H5)	Worst case scenario for conservatism, EPA-approved methodology; supported further delineation and reduction in size of the assessment areas	Limited inorganic data – only chromium evaluated along with Cs-137, Co-60, and Sr-90.	Off-site radiological and inorganic contamination due to wind dispersion is unlikely. Supported reduction of the WAG areas for assessment of de minimis risk.	Medium value (+)

Table 17-29. (continued).

Item	Strengths	Weaknesses	Results	Overall Lines of Evidence Rating for the OU 10-04 Site-wide ERA (+/-)[a]
WAG Biological Surveys (1997-99) (Appendix H7)	The surveys were performed by the Environmental Science and Research Foundation and findings for WAGs 1, 2, 3, 4, 5, 6, 7, 9, and 10 have been documented in a draft report included in Appendix H7.	WAG 8 not included, qualitative, not quantitative, limited effort and does not provide a thorough T/E survey, will need to be updated to support CERCLA 5-year reviews and long-term stewardship issues.	Identified habitat present at WAGs. Was used primarily for supporting the WAG ERAs. Is presented here since it documents the final	Medium value (+/-)
WAG ERA Summaries (Appendices H1 & 2)	Allows rollup to INEEL-wide ERA, identifies receptors at greatest risk from WAG contaminants and the COPCs contributing to these risks.	Problems with some of the ERA results and other methodology inconsistencies; WAG 7 not assessed, characterization at WAGs may be adequate and this information is difficult at this level to evaluate	Identified receptors and COPCs for long-term monitoring and risk characterization	High (-)

a. + Indicates positively supports the overall risk conclusions, - indicates that results do not support the overall risk conclusions.

The long-term vegetation transects are discussed in Section 17.2.4.2 and Appendix H12. When the long-term vegetation transects (plots) were first established in 1950, the area was in a severe drought. Since then, perennial grasses have increased in the plots. This seems to be in step with natural recovery from drought and overgrazing. Since the 1950s, the species richness on the plots has changed very little; however, the plant species heterogeneity has increased. Study plots outside the INEEL have produced similar results. Increases in shrub cover, perennial grasses, mean species richness, and heterogeneity have all been observed, as well as similar relative vascular plant cover. The major difference in the vegetation transects (plots) was the percentage of cover of annuals versus perennials.

The Ecologically Sensitive Areas overlay map (Figure 17-3) presented in the problem formulation identifies several areas as having significant value for supporting sensitive and/or unique on-site plant and wildlife species and communities (Reynolds 1993). The first of these areas is the area along the Big Lost River and Birch Creek. Riparian and wetland communities support a great variety of species. Buffer areas that define a reasonable area to protect these habitats have been identified (Reynolds 1993).

Four ordnance areas have been identified in the OU 10-04 RI to be brought through to the feasibility study (FS): NODA, NOAA, Mine/Fuze Burn Area, and the Fire Station. All four of these areas border the Big Lost River or are within the buffering area of the Big Lost River. RDX and TNT chunks, fuzes (primers), frag (metal fragments), and projectiles were found in these areas. Shrapnel and frag are common to all of the sites, and are found on both sides of the river and in the river itself, which was dry during the walkdowns (see Section 12). Pronghorn, mule deer, elk, raptors, and small mammals were all observed in these areas during the summer of 2000. No sage grouse leks were observed in the ordnance areas stated above. Much of the area that served as a firing range in the 1950s was not surveyed in the field walkdowns in the summer of 2000. As can be seen from Figure 17-3, a significant portion of the buffer areas, sage grouse leks, pronghorn wintering area, and sensitive biological resource areas fall within the footprint of the firing area.

None of the WAG facilities are directly within the buffer for protected areas. However, several of the WAGs either border or fall within sensitive biological resource areas (e.g., WAG 1). Because the facilities are so close to these sensitive biological resources areas and since much of the firing area has not been surveyed, long-term monitoring is advisable.

The WAG Biological Surveys were a similar effort that identified habitat for sensitive species at the WAG sites. The results are documented in Appendix H7. Although limited in scope, the effort supported the WAGs during their RI/FS process and can be used to help focus future monitoring at those WAGs that have superior habitat characteristics. These surveys identified some areas on the WAGs that have significant habitat for sensitive species. The results neither support nor negate the risk conclusions. This type of evaluation can be used as a starting place to identify sites at the WAGs for monitoring. However, additional information is needed on the status of the sites. For example some of the ponds are listed as having positive habitat characteristics but may not be in existence now due to changing facility activities. This was not a formal T/E (threatened or endangered) survey, and did not include species of concern recently identified, such as the sage grouse. A thorough T/E survey needs to be performed to support future long-term monitoring and stewardship issues.

The RESL data presented in Appendix H4, summarizes some of the data collected during various studies from the 1970s to 1980s. These studies focused on radionuclides, were collected for research, were not generally useful for risk assessment purposes, and did not support transport from soil to biota calculations (no co-located soils). It is apparent that many of the sites contributing to risk as presented in Appendix H4 have since been remediated. This information, therefore, is of limited value.

Results from the WAG ERAs were used extensively in this assessment to identify the receptors and contaminants of concern site-wide. From the air dispersion modeling and the ERA sampling at INTEC, it was concluded that contamination is limited to small areas within the WAG boundaries. These areas represent limited ecological habitat relative to the INEEL as a whole. On the other hand, the results show low to significantly high unacceptable risks to several ecological receptors at the WAGs due primarily to metals and explosives.

The 1997 and 2000 ecological sampling activities provided a degree of certainty to the risk conclusions. The limitations of these results were due primarily to the low number of on-Site samples collected, which were located in one small area (CPP plume) relative to the large expanse of the INEEL. To a lesser degree was the lack of organic analytical results. The BAFs (and PUFs) which were calculated for several metals from the 1997 biota and co-located soil data provide a relatively strong degree of confidence that the use of the literature-derived uptake factors were appropriately conservative. As a result, it is likely that potential risks associated with the dietary ingestion pathway are protective of ecological receptors. The 1997 results also support the premise that WAG contamination has not spread off the INEEL and the reduction of the assessment areas. The reduction in assessment areas is also supported by the Warm Waste Pond Air Dispersion Modeling.

17.4.3 Uncertainty Analysis

The ERA uncertainty analysis identifies, and to the extent possible, quantifies the uncertainty in problem formulation, analysis, and risk characterization (EPA 1992). The uncertainties from each of these phases of the process are carried through as part of the total uncertainty of the risk assessment. The product of the uncertainty analysis is an evaluation of the impact of the uncertainties on the overall assessment and, when feasible, a description of the ways in which uncertainty could be reduced. The basic categories include

- Uncertainty in the CSM, TRVs, and exposure parameters
- Assessment area/habitat assessment uncertainty
- Uncertainty in the summary of WAG ERAs
- Uncertainty in the ERA sampling and analysis
- Uncertainty associated with the other lines of evidence (i.e., supporting information).

Uncertainty in the ERA process may be addressed both qualitatively and quantitatively. There are two general approaches to tracking uncertainty quantitatively. The first is to develop point estimates for each exposure parameter and toxicity value, and to obtain a point estimate for the HQ and HI. By using different sets of exposure parameters (i.e., average (or central tendency) or conservative (reasonable maximum exposure [RME]) and toxicity values (i.e., NOAEL and LOAEL), the bounds of uncertainty of the risk estimates can be defined. The second approach is to perform a distributional analysis so that a distribution of the risks can be obtained.

For the WAG ERAs and the OU 10-04 ERA, risk estimates were obtained using a modified RME exposure scenario. The maximum or 95% UCL, whichever was lower, and mean ingestion rates and body weights (BW) were typically used. This approach was meant to be conservative. With the exception of the ecological preliminary remediation goal (Eco-PRG) evaluation for lead (Appendix K), a distributional analysis (such as a Monte Carlo analysis) was deemed unnecessary for the WAG 6 and 10 sites ERAs at the INEEL due to the low risks observed. As a result, the uncertainties in the ERA process will be discussed qualitatively.

17.4.3.1 Uncertainty in the Conceptual Site Model, TRVs, and Exposure Parameters. The CSM was developed as part of the approach for conducting ERAs at the INEEL as presented in the Guidance Manual (Van Horn, et. al, 1995) and in Section 17.2.9. This CSM has been used to represent all of the screening and WAG ERAs as well as the OU 10-04 ERA. As such, there has always been some uncertainty in the selection of receptors, pathways, and exposure parameters. The many functional groups for which quantitative risk estimates were performed reduces the uncertainty that key receptors were not identified or evaluated. Since aquatic habitat is very limited at the INEEL, risk estimates based on the terrestrial habitat account for the vast majority of ecological receptors.

The lack of aquatic data in the WAG ERAs and the OU 10-04 ERA may result in potential underestimation of risk to aquatic receptors. This uncertainty represents a data gap in the overall assessment.

The uncertainty arising from the exposure parameters such as ingestion rates, dietary composition, BWs, and the use of allometric equations to adjust for different species can either overestimate or underestimate intakes. In addition, the use of literature-based uptake factors is conservative, thereby likely overestimating the dietary ingestion pathway risks. The derivation of final TRVs for the various receptors and contaminants typically includes uncertainty factors (UFs) associated with extrapolation from laboratory studies, species-specific intertaxon UFs, and UFs incorporated to adjust toxicity from lethal doses to chronic doses. These UFs are for the extrapolation from one toxicological endpoint to another (endpoint extrapolation). There is an especially large uncertainty in the vegetation toxicity data since soil conditions affect contaminant fate, transport, and bioavailability, and thus, phytotoxicity.

There is also uncertainty associated with the determination of EPCs for each COPC, as discussed below:

Maximum Concentrations. The first step in estimating uptake or intake of COPCs by receptor species is determining the exposure concentrations of COPCs. This step depends on several assumptions that create uncertainty. Screening-level exposure estimates are first based on the highest measured or maximum contaminant concentration for each environmental medium used. This assumes that the receptors present at the site are exposed to the maximum concentrations of COPCs at all times. This is the most conservative approach and ensures that no potential ecological threat is missed.

95% UCL. First, the average exposure concentrations of COPCs are assumed to be accurately represented by the 95% UCL of mean concentrations measured at a site based on an assumed lognormal distribution. This is more conservative than, for instance, using the arithmetic mean COPC concentrations to characterize COPC levels. Moreover, sampling is often a biased process; that is, areas where the highest concentrations of chemicals are suspected are often sampled, which will skew upward the chemical concentration data, and thus the 95% UCL, within site boundaries. The distribution of each analyte is assumed lognormal though no statistical distribution testing was performed. The UCL95 was derived from natural log-transformed data while incorporating the Land H-statistic. This also represents a source of uncertainty in the calculation of the 95% UCLs.

Other sources of uncertainty concerning the use of the 95% UCL as a representative EPC include chemical bioavailability and mobility. Extraction methods used to determine chemical concentrations in soil and sediment are rigorous and destructive; chemicals are often sorbed to soil particles such that they may not be available to ecological receptors under normal environmental conditions. Furthermore, chemicals, whether sorbed or free, are often mobile in soil and may migrate off site through surface water runoff or below ground by leaching. Chemical concentrations measured in a single round of sampling represent a snapshot in time and may not represent persistent exposure concentrations.

Appendix F contains more information regarding uncertainty in the exposure parameters, CSM, and TRVs.

17.4.3.2 Assessment Area/Habitat Assessment Uncertainty. Assessment area delineation is highly uncertain. However, the limited sampling and modeling performed indicate that at WAGs 2 and 3 there should be minimal migration off the facilities. As discussed by VanHorn et al. (1995) and in Appendix F of this document, a component of spatial use, the site use factor (SUF), was included in the risk assessment at the WAG level. The WAG ERA results, therefore, indicate that adverse effects may be likely but difficult to measure. The assessment of the percentage of contaminated area versus overall habitat has been used to evaluate the WAG ERA results on a larger scale. The use of the de minimis risk concept, as discussed in Appendix H6, is problematic since it is difficult to evaluate and measure. The measures of population and community health that are evaluated here are best assessed using some of the long-term studies that have occurred at the facility, including the BBS and LTV transects.

17.4.3.3 WAG ERA Summary Uncertainty. The WAG ERA results have a great deal of uncertainty that is difficult to quantify, in addition to the uncertainties associated with the risk assessment modeling (as discussed in Appendix F). The WAG ERAs have occurred over a period of time from 1995 to 2001. During this time frame, significant changes have occurred in some of the inputs and exposure parameters used (e.g., EBSLs, background values, TRVs, BAFs, PUFs, BWs, and ingestion rates) and may result in a contaminant being eliminated from (moderate probability) or coming into the analysis (low probability).

Limited effort was made to update the risk assessments, and the results of the WAG ERA spreadsheets were simply tabulated. In most cases, the results were consistent between the spreadsheet values and final reports. By establishing a very conservative approach from the beginning of the ERA process at the INEEL, it is expected that all significant contamination and potentially exposed receptors have been adequately addressed in the WAG ERAs. Some small degree of uncertainty exists from this discrepancy, which is expected when assessing a very large and complex site. For those sites deferred to the OU 10-04 ERA, the evaluation of the OU 10-04 ERA sampling results and risk calculations supports the position that contamination on the INEEL is localized, and most sites have addressed their contamination issues through remediation or planned institutional controls. Compared to the INEEL as a whole, the number of contaminated sites is small, the ecological habitat in the WAGs are disturbed and marginal, and the contamination is contained within the WAG boundaries.

Many receptors, including reptiles, amphibians, and invertebrates, have not been assessed. This is primarily due to the limited toxicity data available to support a risk analysis. Many of the species in these groups at the INEEL have been shown to be in decline regionally, (i.e., sagebrush lizard) and may be at risk. These species should be retained as important receptors/indicators for monitoring. There have been no exposure or uptake studies performed at the INEEL for these receptors.

WAG 7 has not assessed the data collected at this WAG for ecological concern. The Environmental Management (EM) program has found elevated concentrations of radionuclides in small mammals at the site; however, EM has not sampled this media at the area since 1990. A summary of the RESL information is presented in Appendix H4. RESL also sampled this area extensively for radionuclides in the 1970s and 80s. However, this information has not been evaluated. A screening, paralleling the human health risk assessment, was performed on concentration of waste as modeled from the existing inventory. It is assumed that the remedial alternative selected at this facility will also protect ecological receptors. It is difficult at this time to address the implications of this approach. Both the EM and RESL efforts should be evaluated to develop a monitoring plan for ecological receptors at this site. This effort will be coordinated with other WAG 10 efforts.

WAG 8 used a qualitative evaluation for risk to ecological receptors. The results of this analysis could not be incorporated into the WAG ERA summaries for the OU 10-04 ERA. Therefore, it is assumed, based on the WAG ERA results, that WAG 8 does not contribute risk to ecological receptors.

The data quality and extent of characterization varies greatly between WAGs and WAG sites, and is most likely the greatest contributor to the uncertainty in the analysis. This may either underestimate or overestimate risks to ecological receptors.

17.4.3.4 Uncertainty in the ERA Sampling and Analysis. There are many sources of uncertainty associated with the planning, collection, analysis, and interpretation of environmental samples. The planning process should incorporate the appropriate elements of EPA's various DQO guidances, and include input from the risk managers and risk assessors and other selected disciplines.

The number and types of samples are frequently restricted, based on available budget. It is often not possible to obtain as many samples as the DQOs suggest. As a result, extrapolations are typically made based on fewer samples and analytes, a process that can introduce considerable uncertainty. It is also possible, due to a limited number of samples and analytes, to entirely miss the contamination. Uncertainty also arises in the selection of various sampling depths. Often, the selection relies heavily on visual observation and professional judgement. The actual collection depths may vary from those planned due to obstructions, cobble, or lack of adequate soil materials.

The very nature of environmental conditions, such as soil inhomogeneity, can result in large variations in the analytical results. These results may overestimate or underestimate the risk calculations, thereby leading to unnecessary remediation or failing to address contamination when actually present. It is not uncommon to observe even greater variation in the concentrations of naturally occurring metals in flora and fauna.

The collection of biotic material presents even greater sampling and analytical challenges. The proper choice of species is very important in order to provide the necessary food web modeling information. This process, too, can be very uncertain; however, incorporating the expertise of persons familiar with risk assessment, laboratory methodologies, and biotic sampling helps to focus efforts at the most representative species, and to obtain the most reliable analytical results. Decisions must be made whether or not to composite samples or analyze as whole-body or whole-plant and other collection, handling, and analysis strategies. Modifications to traditional soil and water analytical methodologies are often required to analyze biotic materials and obtain sufficiently low detection limits.

Field QC samples, as well as laboratory QC samples associated with the analytical methods, help to reduce uncertainty in the data. High MDLs (method detection limits) associated with some analytical methods and matrix interferences may result in nondetects (i.e., false negatives). However, use of 1/2 the detection limit for nondetects in calculating the EPCs helps to minimize the likelihood of underestimating, risk since 1/2 the detection limit is also high in cases where detection limits are evaluated. Professional judgment is necessary when evaluating elevated detection limits and incorporating such results into the risk assessment.

The OU 10-04 ERA included sampling activities conducted in 1997 and 2000. Although similar biotic species were collected (small mammals and vegetation), the locations were different between the two seasons. No samples were obtained from the reference area in 2000 for comparison to the 2000 BORAX results, and no soil invertebrates were collected in 2000. Soil and biota samples were analyzed for metals and radionuclides in both sampling efforts, which helps to reduce uncertainty. The number of samples collected in both sampling efforts was low (i.e., less than 10), which makes statistical evaluations uncertain, especially for establishing population distributions or hypothesis testing.

Some uncertainty in the results may be attributed to having different laboratories perform the analyses. This cannot always be prevented, since three years elapsed between the sampling events. The same INEEL laboratories analyzed the small mammals from both 1997 and 2000 for radionuclides and metals. Thus, those results are expected to be more consistent than the soils and other biotic results. Soils collected in 1997 were all obtained from the 0 to 2 ft depth, whereas the archived soils analyzed in 1999 were obtained at various intervals from surface to two feet below ground surface. The differences in sampling depths both on site and off site makes direct comparisons between data sets less reliable. The BORAX 2000 soil data were collected at both 0 to 0.5 ft and 0.5 to 2 ft, which more closely compare with the archived soil depths.

17.4.3.5 Lines-of-Evidence Uncertainty. Uncertainty exists for the various sources of data collected over the years for other purposes. These sources of supporting information (i.e., lines of evidence) all contain various degrees of uncertainty, which include possible errors in study design, data collection, analysis, and interpretation. Examples include the process of counting avian species (for the BBS) and the analysis and interpretation of the long-term vegetation transects, especially over a period of many years where environmental conditions can change considerably. So, too, the RESL data contain uncertainty in that many of them were collected prior to the remediation of many sites. However, little postremediation sampling has occurred, and what has taken place has not yet been published.

17.4.3.6 Overall Uncertainty. Although there are many sources of uncertainty attributed to the ERA process, only the major issues have been included in this discussion. The risk assessment results indicate that contamination is not widespread and that the majority of INEEL receptors have been adequately evaluated. Although extensive monitoring of radionuclides has occurred off the facilities by Environmental Monitoring, RESL, and the off-site surveillance program, organics and metals are not well characterized. These contaminants may have a greater impact on ecological receptors than the radionuclides. Monitoring of selected receptors and habitats should help to reduce the overall uncertainty in the OU 10-04 ERA process.

17.4.4 Other INEEL Specific Issues

The INEEL is considered an ecological treasure (Anderson, 1999). A special benefit of the site being set aside for government use was the protection of what is arguably the largest expanse of protected sagebrush-steppe habitat anywhere in the United States. Approximately 40% of the INEEL has not been grazed for the past 45 years. Recognizing the importance of this undisturbed area as an ecological field laboratory, the area was also designated as a National Environmental Research Park (NERP) in 1975. This is one of only two such parks in the United States that allows comparative ecological studies in sagebrush-steppe ecosystems (DOE-ID 1997).

July 17, 1999, the Department of Energy, U.S. Fish and Wildlife Service, the Idaho Fish and Game Department, and the Bureau of Land Management created the Sagebrush Steppe Ecosystem Reserve at the INEEL. This reserve will conserve 74,000 acres of unique habitat on the northwest portion of the INEEL. The INEEL contains some of the last sagebrush steppe ecosystem in the United States. This action recognized that the INEEL has been a largely protected and secure facility for 50 years and that portions are valuable for maintaining this endangered ecosystem.

The U.S. Geological Survey (USGS) evaluated endangered ecosystems of the United States (Noss et al., 1998. The study found that in the Southwest and Intermountain West, 30% of the 4.4 million km^2 of arid and semi-arid lands has experienced severe desertification, and another 60% has experienced slight desertification (Dregne 1983). Over 10% of sagebrush steppe has been lost to dryland or irrigated agriculture (West 1994). Of the remaining sagebrush steppe,

- More than 99% has been affected by livestock, and about 30% has been heavily grazed, with the dominance concentrated on a few woody plants (West 1994).

- More than 99% of the Basin big sagebrush habitat on the Snake River plain of Idaho has been converted to agriculture

Noss et. al. (1997) lists both ungrazed sagebrush-steppe in the Intermountain West, and Basin big sagebrush (*Artemisia tridentata*) in the Snake River Plain of Idaho as ecosystems that are critically endangered (>98% decline).

In *America's Forgotten Ecosystem*, Michael Lipske states "that although often maligned and frequently mismanaged, the country's most abundant native shrub is finally getting credit for its value to wildlife. The 900 square miles that make up the grounds of the U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory is one of the best remaining chunks of a type of northwestern U.S. habitat called sagebrush-steppe" (Lipske 2000). In this same article, Tom France states that "the sagebrush environment represents one of America's forgotten ecosystems, one that has high value to neotropical songbirds and other wildlife."

Several wildlife species are found only or primarily in sagebrush habitats throughout their range. About 100 bird, 70 mammal, and 23 amphibian and reptile species in the Great Basin rely to some degree on sagebrush habitat for shelter and food. Some are sagebrush obligates—sagebrush lizard, pygmy rabbit, pronghorn, sage sparrow, brewer's sparrow, sage grouse, loggerhead shrike, and sagebrush vole, which cannot survive without plenty of high-quality sagebrush and its associated perennial grasses and forbs. Other species depend on sagebrush for a significant portion of their diet. For example, pronghorn depend on sagebrush for nearly 90 percent of their diet (Lipske 2000).

Currently, a 1999 report prepared by the Western Working Group of the International Bird Conservation Coalition Partners in Flight warns that more than 50 percent of shrubland and grassland bird species in the Intermountain West show downward population trends. Sage grouse numbers have dipped more than 33 percent in the last 15 years, according to BLM studies. As these species come more and more to the attention of the concerned public, it will be critical to have the information to support the decisions made for the assessment.

Other current risks to the sagebrush-steppe include invasion of both exotic weeds and juniper, subdivision of private lands, improper livestock grazing, and impediments to management practices caused by litigation. The major current risk to maintaining productivity of these communities is the invasion of exotic species across the entire ecoregion and juniper encroachment where native juniper woodlands occur in conjunction with the sagebrush-steppe. In some cases, exotic species may invade undisturbed communities (without grazing or fire), and in other cases, improper livestock grazing and wild or prescribed fire provide disturbances that open communities to invasion. Exotic weed invasion is not clearly understood at this time and management practices are not adequate to prevent such invasion.

17.4.5 Conclusions and Recommendations

The following overall conclusions can be drawn concerning the current situation at the INEEL:

- The contamination from past activities at the WAGs is fairly confined to the WAGs, based on evidence from ERA sampling and air modeling.

- Recent CERCLA cleanup activities have removed or will remove and/or stabilize most of contamination within the WAG sites.

- Impact is limited to a small percentage of overall area (i.e., of total INEEL area) that has been adversely affected by these activities.

- The presence of large areas of undisturbed vegetation has benefited the receptors at the site, primarily the result of reduced grazing.

The evaluation of the assessment area to habitat area was used as a measure for the assessment endpoints. From this analysis, it is evident that less than 20% of the habitats present on the INEEL are lost to facility activities. Therefore, the overall results indicate that there is *de minimis* risk to the INEEL plant communities, terrestrial wildlife communities, species of concern, soil fauna, game species, and prey base. Multiple lines of evidence, as presented in Table 17-29, support the results of this analysis.

This assessment used a population level approach for the evaluation of the receptors at the INEEL, with the assumption that much of our modeling and other characterization has been adequate for evaluating this large facility area. The policy has been to pass the WAG ERA results to the OU 10-04 ERA with the understanding that for populations at the INEEL in the larger perspective the risk is minimal. The WAG ERA results indicate that potential risk at the individual WAGs remains but is not a risk to the population.

This population level assessment would be invalidated by the species on the site obtaining federal T/E listing (e.g., the sage grouse is currently under consideration). Long-term monitoring will be implemented in anticipation of this. With this understanding, the WAG ERA results were evaluated and are used to identify receptors and contaminants of concern at the site-wide level to support long-term monitoring.

The summary of the WAG ERAs determined the COPCs contributing to risk and the receptors at greatest exposure. The list of COPCs and receptors is presented in Section 17.4.1. This list will be used to determine future COPCs and receptors, and to focus the subsequent OU 10-04 ecological monitoring and long-term stewardship.

For WAG 6 and 10 sites, unexploded ordnance (UXO) and explosives in many areas likely represent the greatest risks to ecological receptors. If these items and contaminated soil were left in place, the risks would be due primarily to ingestion of RDX, TNT, and other explosive degradation products. It is uncertain as to whether these materials would be mistakenly ingested as food items by mammalian and avian receptors, but some potential remains for this exposure pathway, especially during preening and grooming activities. Small mammals and ground feeding birds are the most likely receptors to be exposed. Risks associated with accidental detonation of UXO are expected to be minimal

The WAG ERA summaries were used to identify receptors for evaluation of risk for the OU 10-04 ERA and suitable for future monitoring efforts. In Table 17-10, a receptor of concern is shown in parentheses with its appropriate functional group. If an OU 10-04 ERA COPC had an HQ value greater than 10 for a functional group, it was assumed the HQ was for the receptor of concern found in that functional group.

However, based on the WAG ERAs, some apparent risk to receptors at the sites is possible. Other concerns to ecological receptors have been identified. Assessment of effects to ecological receptors due to low levels (minimal risk) of contaminants over long periods of time is difficult. Loss of habitat off and on Site from new facilities/activities may impact populations on the site. Off-Site contamination from surrounding farming activities is also a concern. Ecological monitoring will allow the risk managers to obtain a more realistic interpretation of risk and to detect changes in the populations. These monitoring results would provide the necessary data to further verify modeling and associated assumptions.

In summary, ecological monitoring at the INEEL will provide the following:

- A means to ensure that the assumptions made concerning the extent of contamination from the WAG activities are correct
- A baseline to monitor the contamination remaining at the WAGs
- A baseline for future activities at the facilities
- A means to address certain Native American concerns
- A means to ensure that remediation activities at the INEEL are effective
- An opportunity to support long-term stewardship issues.

Stewardship has been identified as an important concern at the DOE facilities. The continued protection of the environment is identified as a concern. The DOE (2000) has used the following definition from the 1998 Settlement Agreement: "The concept of long-term stewardship includes, *inter alia*, land-use controls, monitoring, maintenance, and information management."

As discussed in the INEEL-specific issues section, the sagebrush ecosystem is currently considered endangered and many of the associated species are being considered for special protection. As the sagebrush ecosystem and associated species experience more pressure from human activities, the associated importance of protecting areas like the INEEL will become greater. It will be important to have the information from this risk assessment to support future efforts at the site. Monitoring will allow reduction of uncertainty and provide the necessary information to make informed decisions in the future. The WAG sites typically represent small areas of significant human disturbance. As such, they have limited ecological habitat and are not likely to pose unacceptable risks to ecological populations or to any individual T&E or special status species.

17.5 References

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